NAVAIR 17-20AA-25
NAVSHIPS

Technical Manual

Instrument Calibration Procedure

AA-25
RECORDER
MODEL 67-1200

(Sanborn Company)

THIS PUBLICATION SUPERSEDES NAVWEPS 17-20AA-25
DATED 1 SEPTEMBER 1965

DEPARTMENT OF THE NAVY CALIBRATION PROGRAM

PUBLISHED BY DIRECTION OF
THE COMMANDER OF THE NAVAL AIR SYSTEMS COMMAND

1 JULY 1966

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SECTION 1

INTRODUCTION AND DESCRIPTION

1.1 This procedure describes the calibration of the Sanborn 67-1200 recorder, herein referred to as the Test Instrument. The Test Instrument consists of four stylus penmotors and one marker stylus.

1.2 This procedure was prepared for the Metrology Engineering Center, BWR, Pomona, California, by The Boeing Company, Aerospace Division, Seattle, Washington, under contract N123(62861)35056A. All comments concerning this procedure should be directed to the Metrology Engineering Center.

Table 1. Calibration Description

Test Instrument Characteristics	Performance Specifications	Test Method
Sensitivity and linearity	Sensitivity: 10 ma/cm deflection Linearity: Over middle 4 cm of chart; ± 0.25 mm Over entire 5 cm of chart; ± 0.5 mm	A stylus deflection is produced with a direct voltage supply and verified on the chart paper.
Chart speed	Speed: 2.5, 5, 10, 25, and 50 mm/sec Limit of Error: ± 0.5%	The distance the chart travels is compared with the distance between accurately spaced square waves at a 25 mm/sec chart speed. Trace legibility is also tested at all chart speeds.
Marker stylus	When energized, produces a small spike at 1 second intervals	Tested during the chart speed test.
Response to square wave	Critically damped: Overshoot, none; % of final deflection reached in first 0.01 seconds = 80%	Not tested.
	Damped 71% of critical: Overshoot, 4%; % of final deflection reached in first 0.01 seconds = 95%	Tested by applying a 1 cps square wave and observing the recording.
Response to sine wave	Critically damped: Frequency for 3 db loss, 30 Hz Frequency for 6 db loss, 45 Hz	Not tested.
	Damped 71% of critical: Frequency for 3 db loss, 45 Hz Frequency for 6 db loss, 60 Hz	Tested by applying a sine wave from an oscillator.

SECTION 2

EQUIPMENT REQUIREMENTS[1]

NOTE: Minimum use specifications are the principal parameters required for performance of the calibration, and are included to assist in the selection of alternate equipment. Satisfactory performance of alternate items shall be verified prior to use. All applicable equipment must bear evidence of current calibration.

Item	Minimum Use Specifications	Calibration Equipment
2.1 Direct voltage source	Output: 0 to 175 volts at 26 ma	John Fluke 406
2.2 Decade resistor	Range: 1000 and 1350 ohms Limit of error: ± 0.05% Current rating: 23 ma	General Radio 1432B, W, N, or P
2.3 Differential voltmeter	DV range: 5 to 26 volts DV accuracy: ± 0.1% of reading DV input impedance: infinite at null AV range: 1 to 10 volts rms from 10 to 45 Hz AV limit of error: ± 0.5%	John Fluke 803D, 803B/AG, or 803
2.4 Electronic counter	Time base stability: ± 5 parts in 10^8 Must be capable of making a 10 period average measurement of 1 Hz with a limit of error of 0.25%	Beckman 6146 and 607 Hewlett-Packard 5243L Hewlett-Packard 524C or D
2.5 Oscillator	Frequency: 0.05 to 60 Hz Limit of error: ± 3% of setting Output: 1 to 10 volts rms Output impedance: 4000 ohms Output waveforms: Sinusoidal and square	Hewlett-Packard 202A
2.6 Power amplifier	Output: up to 2 watts Input: 10 volts Gain: variable Frequency: DC to 100 kHz Distortion: Less than 0.1%	Krohn-Hite DCA-10

[1]The instruments utilized in this procedure were selected from those known to be available at Department of Defense facilities, and the listing by make or model number carries no implication of preference, recommendation, or approval by the Department of Defense for use by other agencies. It is recognized that equivalent equipment produced by other manufacturers may be capable of equally satisfactory performance in the procedure.

SECTION 3

PRELIMINARY OPERATIONS

3.1 Visually inspect the Test Instrument for defects.

3.2 Verify that all power switches are off and connect all auxiliary equipment to the appropriate power source.

3.3 Set all auxiliary equipment controls as necessary to prevent dangerous output voltages and equipment damage when power switches are turned on.

3.4 Turn all power switches on, and verify that the Test Instrument chart drive motor is operating.

3.5 Set the Test Instrument PAPER SPEED MM/SEC selector to 5, and engage the Paper Drive clutch. Adjust the STYLUS TEMP control as required.

3.6 Disconnect all signal inputs to the Styli (usually a large plug).

3.7 Verify that each Test Instrument Stylus is at the center of each respective chart. If not, take corrective action.

3.8 Disengage the Test Instrument Paper Drive clutch.

SECTION 4

CALIBRATION PROCESS

NOTE

Unless otherwise specified, verify the results of each test and take corrective action before proceeding.

4.1 SENSITIVITY AND LINEARITY TEST

WARNING

VOLTAGES HAZARDOUS TO LIFE ARE PRESENT AT THE TEST INSTRUMENT STYLUS CONNECTION TERMINALS. USE EXTREME CAUTION. THE STYLI OPERATE AT HIGH TEMPERATURES. USE CAUTION TO AVOID BURNS.

4.1.1 Connect the applicable equipment to the Test Instrument Galvo #1 as shown in figure 1.

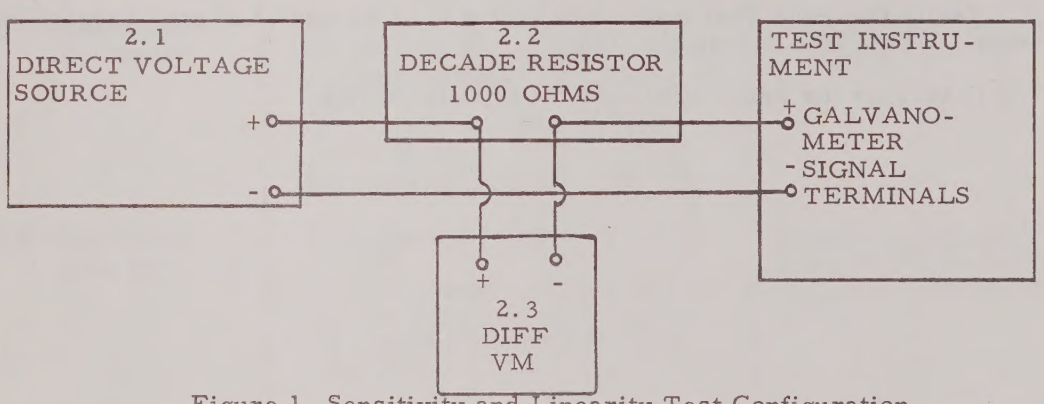

Figure 1. Sensitivity and Linearity Test Configuration

4.1.2 Set the decade resistor to 1000 ohms and engage the Test Instrument paper drive clutch.

4.1.3 Adjust the d-v source until the differencial voltmeter indicates exactly 25 volts.

4.1.4 Verify that the Test Instrument stylus deflection is at least 25 mm.

4.1.5 Adjust the d-v source for a Test Instrument stylus deflection of 5 mm. Verify that the required voltage is between 4.75 and 5.25 volts.

4.1.6 Adjust the d-v source controls to obtain the stylus deflections listed below. At each deflection, verify that the differential voltmeter indication is within the limits specified.

Test Instrument Stylus Deflection	Differential Voltmeter Indication Limits
10 mm	9.75 to 10.25 volts
15 mm	14.75 to 15.25 volts
20 mm	19.75 to 20.25 volts
25 mm	24.50 to 25.50 volts

4.1.7 Adjust the d-v source for minimum output and reverse the d-v source output and differential voltmeter input connections.

4.1.8 Repeat steps 4.1.3 through 4.1.6.

4.1.9 Adjust the d-v source for minimum output.

4.1.10 Repeat the procedure described in steps 4.1.3 through 4.1.9 for Test Instrument galvanometers 2, 3, and 4.

4.2 CHART SPEED AND MARKER TEST

4.2.1 Connect the equipment to the Test Instrument Galvo #1 as shown in figure 2.

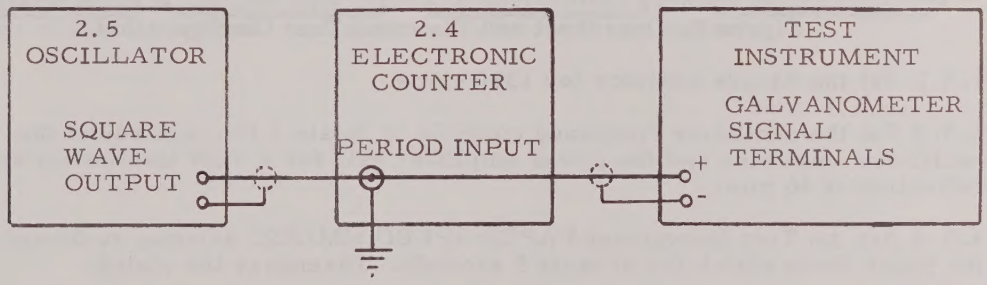

Figure 2. Chart Speed and Marker Test Configuration

4.2.2 Set the Test Instrument TIMER switch to ON.

4.2.3 Set the oscillator frequency controls to obtain to 0.25 Hz.

4.2.4 Set the Test Instrument PAPER SPEED MM/SEC selector to 25.

4.2.5 Engage the Test Instrument Paper Drive clutch and allow the chart paper to run for at least 5 seconds.

4.2.6 Disengage the Test Instrument Paper Drive clutch.

4.2.7 Measure the distance between the leading edges of the square waves displayed, and verify that it is between 99.5 and 100.5 mm.

4.2.8 Verify that the marks produced by the Test Instrument TIMER are displayed on the chart paper at 25 mm intervals.

4.2.9 Set the Test Instrument PAPER SPEED MM/SEC selector to the speeds listed below, and adjust the oscillator controls to obtain the indicated frequency. At each setting, verify that the trace produced is legible and clear with no burning.

Test Instrument Paper Speed mm/sec	Oscillator Frequency
25	0.25 cps
50	0.5 cps
10	0.1 cps
5	0.05 cps
2.5	0.05 cps

4.2.10 Repeat the procedure described in steps 4.2.1 through 4.2.9 for Test Instrument galvanometers 2, 3 and 4.

4.3 OVERSHOOT AND RISETIME TEST

4.3.1 Connect the applicable equipment to the Test Instrument Galvo #1 as shown in figure 3.

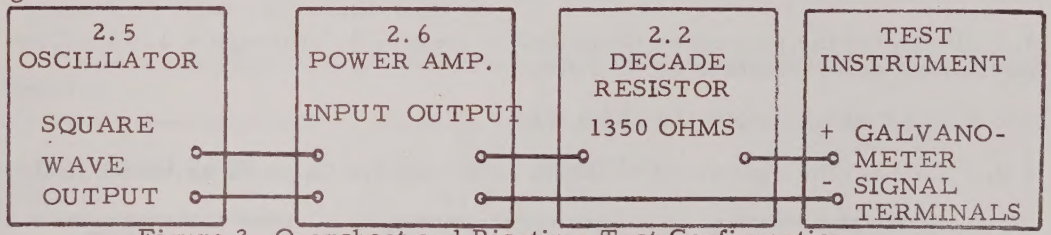

Figure 3. Overshoot and Risetime Test Configuration

4.3.2 Set the decade resistor for 1350 ohms.

4.3.3 Set the oscillator frequency controls to obtain 1 Hz, and adjust the oscillator amplitude and the power amplifier gain for a Test Instrument stylus deflection of 46 mm.

4.3.4 Set the Test Instrument PAPER SPEED MM/SEC selector to 50 and engage the paper drive clutch for at least 5 seconds. Disengage the clutch.

4.3.5 Verify that the overshoot of the displayed square wave is 1.8 mm, or less.

4.3.6 Verify that 95% of the deflection (44 mm) is reached in the first 0.5 mm of paper travel.

4.3.7 Repeat the procedure described in steps 4.3.1 through 4.3.6 for the Test Instrument galvanometers 2, 3 and 4.

4.4 RESPONSE TO SINE WAVE TESTS

4.4.1 Connect the applicable equipment to the Test Instrument Galvo #4 as shown in figure 4.

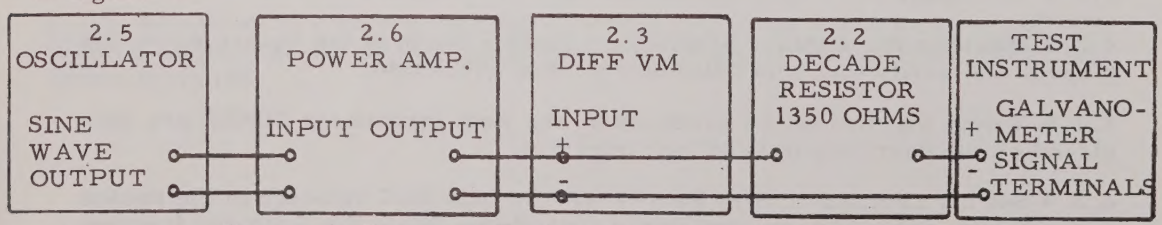

Figure 4. Response To Sine Wave Test Configuration

4.4.2 Set the Test Instrument PAPER SPEED MM/SEC selector to 10 and engage the paper drive clutch.

4.4.3 Adjust the oscillator frequency controls to obtain 10 Hz, and the amplitude control until the Test Instrument stylus deflection is exactly 46 mm peak-to-peak.

4.4.4 Note the oscillator output amplitude as measured with the differential voltmeter.

4.4.5 Adjust the oscillator frequency controls to obtain 45 Hz, and the amplitude control until the oscillator output amplitude is the same as that noted in step 4.4.4.

4.4.6 Verify that the Test Instrument stylus deflection is 32.5 mm peak-to-peak, or more.

4.4.7 Adjust the oscillator frequency controls to obtain 60 Hz, and the amplitude control until the oscillator output amplitude is the same as that noted in step 4.4.4.

4.4.8 Verify that the Test Instrument stylus deflection is 23 mm peak-to-peak, or more.

4.4.9 Repeat the procedure described in steps 4.4.1 through 4.4.8 for Test Instrument galvanometers 3, 2 and 1.

4.4.10 Unless other measurements are to be performed, turn all power switches to the off or standby positions, and disconnect the Test Instrument.

TEST INST (S):
SAA 67-1200 RECORDER

PROC NO. NW 17-20AA-25 MFR MODEL SER NO.

PROCEDURE STEP NO. (1)	FUNCTION TESTED (2)	NOMINAL (3)	MEASURED VALUES FIRST RUN (4)	MEASURED VALUES SECOND RUN (5)	OUT OF TOL ✓ (6)	CALIBRATION TOLERANCES (7)
3.1	Test Inst. insp.	---	ck( )			no defects
3.4	Chart drive motor	---	ck( )			operating
3.7	Styli centered	---	ck( )			-0.05 to +0.05 mm
4.1	SENSITIVITY AND LINEARITY TEST					
4.1.4	Sen. Galvo 1 25 v	---	mm			25 mm minimum
4.1.5	Lin. Galvo 1 5 mm	5 v	v			4.75 to 5.25 v
"	" 1 10 "	10 "	"			9.75 " 10.25 "
"	" 1 15 "	15 "	"			14.75 " 15.25 "
"	" 1 20 "	20 "	"			19.75 " 20.25 "
"	" 1 25 "	25 "	"			24.50 " 25.50 "
4.1.8	Sen. Galvo 1 25 v	---	mm			25 mm minimum
"	Lin. Galvo 1 5 mm	5 v	v			4.75 to 5.25 v
"	" 1 10 "	10 "	"			9.75 " 10.25 "
"	" 1 15 "	15 "	"			14.75 " 15.25 "
"	" 1 20 "	20 "	"			19.75 " 20.25 "
"	" 1 25 "	25 "	"			24.50 " 25.50 "
4.1.10	Sen. Galvo 2 25 v	---	mm			25 mm minimum
"	Lin. Galvo 2 5 mm	5 v	v			4.75 to 5.25 v
"	" 2 10 "	10 "	"			9.75 " 10.25 "
"	" 2 15 "	15 "	"			14.75 " 15.25 "
"	" 2 20 "	20 "	"			19.75 " 20.25 "
"	" 2 25 "	25 "	"			24.50 " 25.50 "
"	Sen. Galvo 2 25 v	---	mm			25 mm minimum
"	Lin. Galvo 2 5 mm	5 v	v			4.75 to 5.25 v
"	" 2 10 "	10 "	"			9.75 " 10.25 "
"	" 2 15 "	15 "	"			14.75 " 15.25 "
"	" 2 20 "	20 "	"			19.75 " 20.25 "
"	" 2 25 "	25 "	"			24.50 " 25.50 "
"	Sen. Galvo 3 25 v	---	mm			25 mm minimum
"	Lin. Galvo 3 5 mm	5 v	v			4.75 to 5.25 v
"	" 3 10 "	10 "	"			9.75 " 10.25 "
"	" 3 15 "	15 "	"			14.75 " 15.25 "
"	" 3 20 "	20 "	"			19.75 " 20.25 "
"	" 3 25 "	25 "	"			24.50 " 25.50 "
"	Sen. Galvo 3 25 v	---	mm			25 mm minimum

TEST INST ($): SAA 67-1200 RECORDER

PROC NO. NW 17-20AA-25 MFR MODEL SER NO.

PROCEDURE STEP NO. (1)	FUNCTION TESTED (2)	NOMINAL (3)	MEASURED VALUES FIRST RUN (4)	MEASURED VALUES SECOND RUN (5)	OUT OF TOL ✓ (6)	CALIBRATION TOLERANCES (7)
4.1.10	Lin. Galvo 3 5 mm	5 v	v			4.75 to 5.25 v
"	" 3 10 "	10 "	"			9.75 " 10.25 "
"	" 3 15 "	15 "	"			14.75 " 15.25 "
"	" 3 20 "	20 "	"			19.75 " 20.25 "
"	" 3 25 "	25 "	"			24.50 " 25.50 "
"	Sen. Galvo 4 25 v	---	mm			25 mm minimum
"	Lin. Galvo 4 5 mm	5 v	v			4.75 to 5.25 v
"	" 4 10 "	10 "	"			9.75 " 10.25 "
"	" 4 15 "	15 "	"			14.75 " 15.25 "
"	" 4 20 "	20 "	"			19.75 " 20.25 "
"	" 4 25 "	25 "	"			24.50 " 25.50 "
"	Sen. Galvo 4 25 v	---	mm			25 mm minimum
"	Lin. Galvo 4 5 mm	5 v	v			4.75 to 5.25 v
"	" 4 10 "	10 "	"			9.75 " 10.25 "
"	" 4 15 "	15 "	"			14.75 " 15.25 "
"	" 4 20 "	20 "	"			19.75 " 20.25 "
"	" 4 25 "	25 "	"			24.50 " 25.50 "
4.2	CHART SPEED AND MARKER TEST					
4.2.7	25 MM/SEC	100 mm	mm			99.5 to 100.5 mm
4.2.8	TIMER marks	1/sec	ck( )			one mark every 25 mm
4.2.9	Galvo 1	---	ck( )			legible trace at all speeds
4.2.10	" 2	---	ck( )			"
"	" 3	---	ck( )			"
"	" 4	---	ck( )			"
4.3	OVERSHOOT AND RISETIME TEST					
4.3.5	Overshoot Galvo 1	---	mm			1.8 mm maximum
4.3.6	Risetime " 1	---	"			at least 44 mm in first 0.5 mm
4.3.7	Overshoot " 2	---	"			1.8 mm maximum
"	Risetime " 2	---	"			at least 44 mm in first 0.5 mm
"	Overshoot " 3	---	"			1.8 mm maximum
"	Risetime " 3	---	"			at least 44 mm in first 0.5 mm
"	Overshoot " 4	---	"			1.8 mm maximum
"	Risetime " 4	---	"			at least 44 mm in first 0.5 mm

TEST INST (S): SAA 67-1200 RECORDER

PROC NO. NW 17-20AA-25 MFR MODEL SER NO.

PROCEDURE STEP NO. (1)	FUNCTION TESTED (2)	NOMINAL (3)	MEASURED VALUES FIRST RUN (4)	MEASURED VALUES SECOND RUN (5)	OUT OF TOL ✓ (6)	CALIBRATION TOLERANCES (7)
4.4	RESPONSE TO SINE WAVE TEST					
4.4.6	Galvo 4 45 Hz	---	mm			32.5 mm p-p min.
4.4.8	" 4 60 "	---	"			23 mm p-p min.
4.4.9	" 3 45 "	---	"			32.5 mm p-p min.
"	" 3 60 "	---	"			23 mm p-p min.
"	" 2 45 "	---	"			32.5 mm p-p min.
"	" 2 60 "	---	"			23 mm p-p min.
"	" 1 45 "	---	"			32.5 mm p-p min.
"	" 1 60 "	---	"			23 mm p-p min.